MedicalXpress

Drug-resistant bacteria lurk in subway stations, high school students discover

February 5 2015

Forget the five-million plus commuters and untold number of rats - many of the living things crowded into the New York City subway system are too small to see. An interest in the more menacing among these microbes led high school student Anya Dunaif, a participant in Rockefeller's Summer Science Research Program, to spend her vacation swabbing benches and turn styles beneath the city. Among her findings: bacteria impervious to two major antibiotics.

The samples she collected and cultured in five stations are a component of a city-scale environmental DNA sampling effort led by Chris Mason, an assistant professor at Weill Cornell Medical College with support from Rockefeller's Science Outreach program, as well as from numerous local, national and international collaborators. This project, called Pathomap, seeks to profile the city's microbial community, or microbiome, while also capturing DNA from other organisms, all of which could potentially be used to assess biological threats, including those to human health. The project's initial results are described in a paper published Wednesday (February 4) in *Cell Systems*.

With help from fellow high school student researcher Nell Kirchberger, Dunaif collected the bacteria on swabs and tested to see if they would grow in Petri dishes containing three commonly used antibiotics. Bacteria from five of the 18 swabs she tested grew in spite of the presence of either ampicillin or kanamycin, and in one case, both. None of the cultured bacteria appeared resistant to the third antibiotic, chloramphenicol.

Antibiotic resistance - the ability of disease-causing bacteria to withstand compounds used to kill them off - can make a once treatable infection more serious, even life threatening. A natural consequence of evolution, and the widespread use and misuse of antibiotics, resistance is increasing worldwide.

"Although I knew resistance is considered a serious threat to modern medicine, I went into this project not certain what to expect. I wasn't even sure we would see antibiotic-resistant bacteria, let alone multi-drug resistant bacteria," says Dunaif, a senior at St. Ann's School in Brooklyn. "Now we hope to build off the work I did over the summer by searching for more types of antibiotic resistance in more stations."

Joining her on the continuing search for drug-resistant bugs are Anya Auerbach, a senior at the Ethical Culture Fieldston School, and Will Lounsbery-Scaife, now a freshman at New York University. (Kirchberger has since returned to California.) Both took on their own projects over the summer, although their work was not included in the current Pathomap publication.

Now the three of them, with guidance from Jeanne Garbarino, director of Rockefeller's Science Outreach Program, are preparing a rigorous sampling protocol they plan to test at the Lexington Avenue/59th Street station, and getting ready to look for resistance against four additional antibiotics. As part of this contribution to Pathomap's ongoing work, they intend to use genetic sequencing and analysis provided by Weill Cornell Medical College to identify the resistance genes and the molecular pathways the microbes that contain them use to evade the drugs.

"There's no question, high school students can do legitimate primary research. If we are going to encourage critical thinking, which is important regardless of what you do in life, I think it is important to have

them ask and attempt to answer open-ended questions," Garbarino says.

Lounsbery-Scaife spent his summer swabbing water fountains in Central Park. The sequencing results aren't complete yet, but the experience, he says, has given him a better understanding of the scientific process, not just the results.

"It has de-romanticized the whole process for me, but not in a bad way. I learned how slow and consistent you have to be throughout, writing everything down and doing everything exactly the same way. This might deter some people from wanting to do science, but for me, it just validates my interest in it," Lounsbery-Scaife says.

Auerbach, meanwhile, attempted to track microbes as they accumulated over time on Grand Central Station ticket machines. Her effort, which she says attracted a surprising lack of interest from subway riders, was unsuccessful because she couldn't get enough DNA. Nevertheless, she sees value in the disappointment.

"I was hoping to get something really cool and exciting and instead it was like, nope, we can't even sequence this. I did a lot of troubleshooting, and I am confident that if there was something there we would have gotten it," Auerbach says.

Auerbach's results are actually quite typical of research done even by professional scientists, Garbarino says. "Someone said to me when I was in grad school for every 99 failures there is one success. It's not about a grand slam every time you are up to bat, it's about strategy and working with your team to get someone to home plate. As our students learned, that may be slow and tedious at times, but it is gratifying nonetheless."

In addition to antibiotic-resistance, Pathomap's surveys also turned up fragments of DNA that correspond to well-known disease causing

microbes, including plague and anthrax bacteria. However, the authors note, microbes that left behind this DNA do not appear to be causing widespread disease; instead they may simply represent normal inhabitants of urban infrastructure.

Provided by Rockefeller University